Slab ASE 01

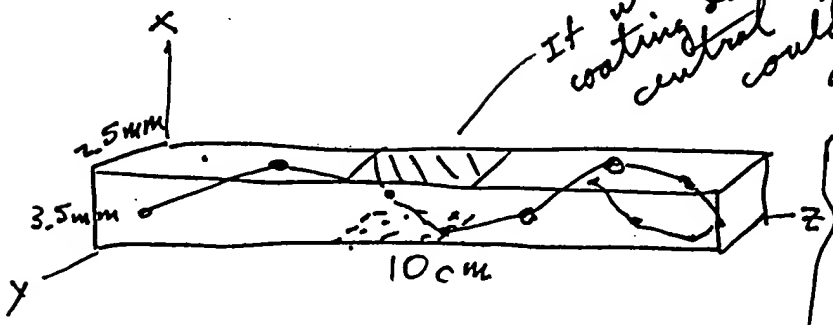
Inputs:

10	slab length (cm)
0.35	slab height (cm)
0.25	slab thickness (cm)
1.82	slab refractive index
1.6	parasitic coating index
0.08	specific gain (nepers/cm)
100000	number of rays to launch

More than 1000 parasitic rays from found

Outputs:

0.08	maximum gain (nepers/cm)
-21.9501	minimum gain (nepers/cm)



It we could apply a diffuse coating strictly to YAG over the central 2 cm or so we could probably suppress all parasitic modes

a kind of barrel mode parasitic exists.

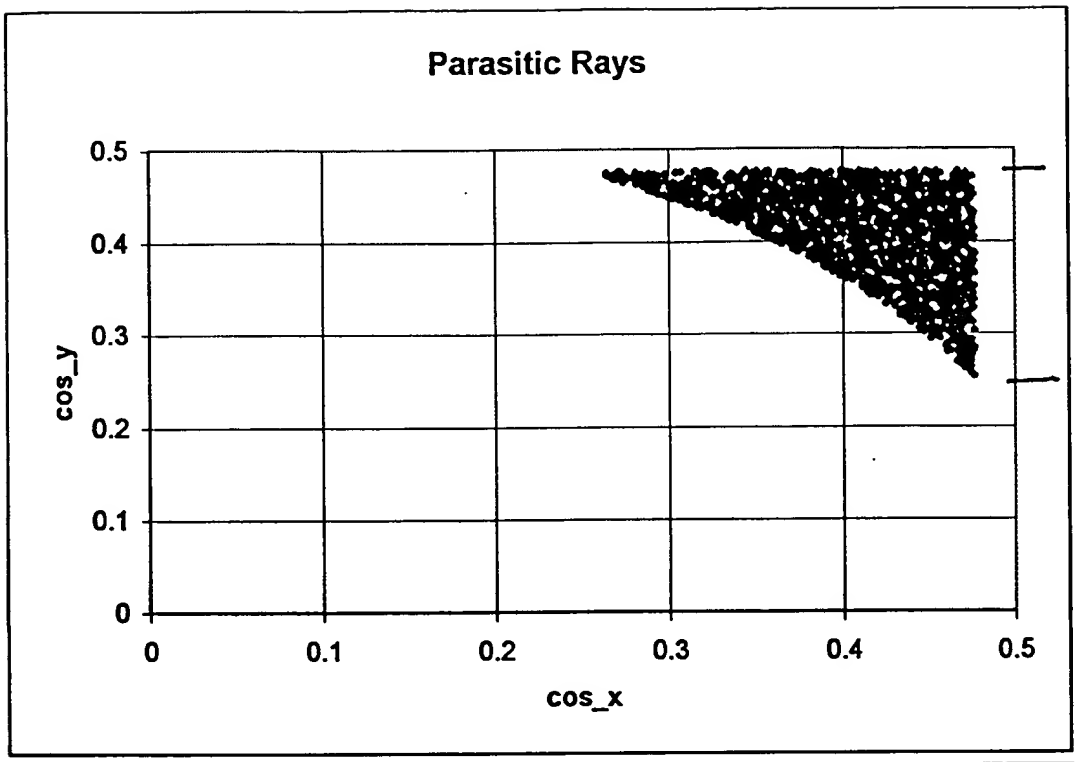
For $n_c < \sqrt{n_s^2 - 1/2^2} \approx$ this can be a zero-loss parasitic mod

For Parasitic Mode:

Average distance travelled between strikes on top and bottom $\approx \frac{3.5mm}{.4} = 8.75mm$

Average distance travelled between strikes on left and right sides $\approx \frac{2.5mm}{.4} = 6.25mm$

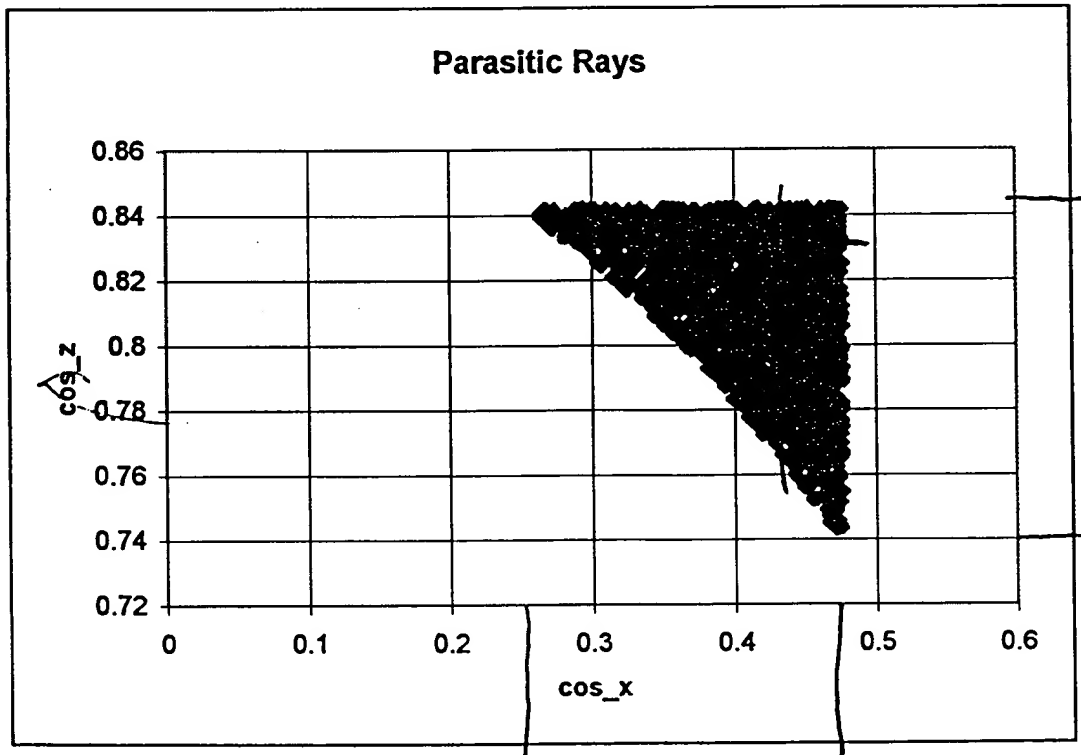
Average distance travelled between strikes on slab ends $\approx \frac{10cm}{.82} = 12.2cm$



.47 ⟵ ≈ θ_c
62°

13

.25
75°



.842 ⟵ ≈ θ_c
32.6°

10°

.740
42.3°

.25
75°

.47
62°

13°

≈ θ_c

```
Dim GainDistribution(1000)
Const pi As Double = 3.141592654

Sub Main()
'
' Main Macro
' Macro recorded          by Raymond J. Beach
'
' Keyboard Shortcut: Ctrl+u
'

'Get input parameters
    Worksheets("sheet1").Select
    Range("length").Select: SlabLength = ActiveCell.Value
    Range("height").Select: SlabHeight = ActiveCell.Value
    Range("thickness").Select: SlabThickness = ActiveCell.Value
    Range("slabindex").Select: SlabIndex = ActiveCell.Value
    Range("coatingindex").Select: CoatingIndex = ActiveCell.Value
    Range("specificgain").Select: SpecificGain = ActiveCell.Value
    Range("numberofrays").Select: NumberOfRays = ActiveCell.Value

'Define other parameters
    NumberOfParasiticDirections = 0
    Nbins = 100
    MaxGain = SpecificGain
    Range("maximumgain").Select: ActiveCell.Value = MaxGain
    RelativeIndex = SlabIndex / CoatingIndex
    If SlabHeight < SlabThickness Then
        MinGain = 2 * Log((RelativeIndex - 1) / (RelativeIndex + 1)) / SlabHeight
    Else
        MinGain = 2 * Log((RelativeIndex - 1) / (RelativeIndex + 1)) / SlabThickness
    End If
    Range("minimumgain").Select: ActiveCell.Value = MinGain

'Initialize the random number generator
    Randomize

'Start the launch cycle
For i = 1 To NumberOfRays

'Define a random launch direction in (+,+,+)quadrant using direction cosines to define the dire
tion
    Phi = (pi / 2) * Rnd
    Theta = (pi / 2) * Rnd
'x is the slab height direction
'y is the slab thickness direction
'z is the slab length direction
    cx = Sin(Theta) * Cos(Phi)  'direction cos in x-direction
    cy = Sin(Theta) * Sin(Phi)  'direction cos in y-direction
    cz = Cos(Theta)             'direction cos in z-direction

'Define unpolarized Fresnel reflection coefficients for three different planes that generate im
ge space
    'x-plane calculation
    Theta1 = ArcCos(cx)
    Temp = SlabIndex * Sin(Theta1) / CoatingIndex
    If Abs(Temp) > 1 Then
        Refx = 1
    Else
        Theta2 = ArcSin(Temp)
        Refx = ((Sin(Theta1 - Theta2) / Sin(Theta1 + Theta2)) ^ 2 + (Tan(Theta1 - Theta2) / Tan
Theta1 + Theta2)) ^ 2) / 2
    End If
    'y-plane Calculation
    Theta1 = ArcCos(cy)
    Temp = SlabIndex * Sin(Theta1) / CoatingIndex
    If Abs(Temp) > 1 Then
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        Refy = 1
    Else
        Theta2 = ArcSin(Temp)
        Refy = ((Sin(Theta1 - Theta2) / Sin(Theta1 + Theta2)) ^ 2 + (Tan(Theta1 - Theta2) / Tan
Theta1 + Theta2)) ^ 2) / 2
    End If
    'z-plane calculation
    Theta1 = ArcCos(cz)
    Temp = SlabIndex * Sin(Theta1)
    If Abs(Temp) > 1 Then
        Refz = 1
    Else
        Theta2 = ArcSin(Temp)
        Refz = ((Sin(Theta1 - Theta2) / Sin(Theta1 + Theta2)) ^ 2 + (Tan(Theta1 - Theta2) / Tan
Theta1 + Theta2)) ^ 2) / 2
    End If

'Calculate the loss per cm in nepers/cm due to x, y, and z reflections
    Nepersx = cx * Log(Refx) / SlabHeight
    Nepersy = cy * Log(Refy) / SlabThickness
    Nepersz = cz * Log(Refz) / SlabLength

'Calculate the net gain-loss in nepers/cm seen by this ray
    Nepers = SpecificGain + Nepersx + Nepersy + Nepersz

'Bin this launch
    BinNumber = Nbins * (Nepers - MinGain) / (MaxGain - MinGain)
    If BinNumber < 0 Then BinNumber = 0
    GainDistribution(BinNumber) = GainDistribution(BinNumber) + 1

    If Nepers > 0 Then
        Beep
        NumberOfParasiticDirections = NumberOfParasiticDirections + 1
        Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 1).Value = cx
        Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 2).Value = cy
        Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 3).Value = cz
        Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 4).Value = Refx
        Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 5).Value = Refy
        Worksheets("sheet2").Cells(1 + NumberOfParasiticDirections, 6).Value = Refz
        Check = Sqr(cx ^ 2 + cy ^ 2 + cz ^ 2)
     End If

Next i

End Sub

Function ArcCos(C)
'Returns the Arc Cos of C.

    If C = 0 Then
        ArcCos = pi / 2
    Else
        ArcCos = Atn(Sqr(1 - C ^ 2) / C)
    End If

End Function

Function ArcSin(S)
'Returns the Arc Sin of S

    If S = 1 Then
        ArcSin = pi / 2
    Else
        ArcSin = Atn(S / Sqr(1 - S ^ 2))
    End If

End Function
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